Art
&
Physics

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Pioneer 10 (1972) & 11 (1973) - Plaque - message to ET
Art & Science: what is in common?

- Both should be done by passion (do it with passion or don’t do it at all?)
- Both try to see and understand unseen (unseen govern the universe and us)
- Art and science teach us to think out of the box, teach us not to be slave of narratives ...
- Thought free of any prejudices is the most powerful substance in the universe
- Art and science are ways of exploring our existence, what is it to be human and what is our place in the universe
- Genuine art and science deals with things for which words do not exist
- (Or less polite way to say): Without art & science we will be reduced to fowl/poultry

**Culture = art + science ≠**
Creativity in Art & Science

- **What is art:** “The expression or application of human creative skill and imagination, typically in a visual form such as painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power.”

- **Artwork is unique and unrepeatable.**

- **Definition of science:** “Knowledge of nature or study of nature based on facts collected by observation or experiment.” (not that spectacular definition as art)

- **Science is repeatable**

- **Creativity:** “No one has ever been able to define or synthesise that precarious, splendid, and perhaps untidy instant when the creative process begins. This is what the uniqueness of the artist is all about. The transcendent right of the artist is the right to create even though he may not always know what he is doing.” (Norman Cousins)
The spirit of time (narratives)

- Zeitgeist/the spirit of time, is the dominant set of ideals and beliefs that motivate the actions of the members of a society in a particular period in time, defining the intellectual convictions, ideas, thoughts, in the certain period of time and thus creating a sociological, cultural, and religion climate as well aesthetic of certain period.

- **Culture = science + art**
- Science creates spirit (geist) of time (zeith)
- Art expresses/interprets spirit (geist) of time (zeith)
- **Both art and science teach us to think in a different way** (new thought and emotion are going through our minds thanks to art and science)

- **Art and science develop the ability of abstract thinking - the most powerful tool in the universe**

- Science seeks to understands what is that what governs the natural phenomena and art what is that what govern us, humans ....
In the 8th century BC the Greeks borrowed from the Phoenician alphabet, adapted its to their language, introduced vowels ... it is the first true alphabet.
The first abstract art - alphabet

The best one you can find on island Hvar 😊
2500 years ago, people began to use a new tool: reason!

Tales, the father of science, first bravely said that there is no need to consult gods at Olympus to explain the natural phenomena.

Euclid (geometry) - creates the spirit of time

This spirit of time is clearly visible in antique art …

For the first time, time and space are measured, units for space and time start to be used (Eratosten measured with the astonishing precision the Earth radius)

Sculptor Polykleitos writes a treatise (Kanon) in which he defines the proportions of the human body as an aesthetic principle.

It creates a famous statue of the "Spear Bearer" to prove that the human body ratios are the basis of aesthetics.

Aesthetics is coded over numbers/maths!
Euclid geometry - science about space.

At the entrance of the Platonic Academy (387 BC):

Let none unversed in geometry enter here

It might be good idea to start reuse this motto on the entrance at the political institutions 😞
Euclid's Postulates* - geometry of the flat space

1. A straight line segment can be drawn joining any two points.
2. Any straight line segment can be extended indefinitely in a straight line.
3. Given any straight line segment, a circle can be drawn having the segment as radius and one endpoint as centre.
4. All right angles are congruent.
5. If two lines are drawn which intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, than the two lines inevitably must intersect each other on that side if extended far enough. This postulate is equivalent to what is known as the parallel postulate.


Euclid's fifth postulate cannot be proven as a theorem, although this was attempted by many people. Euclid himself used only the first four postulates ("absolute geometry") for the first 28 propositions of the Elements, but was forced to invoke the parallel postulate on the 29th. In 1823, Janos Bolyai and Nicolai Lobachevsky independently realised that entirely self-consistent "non-Euclidean geometries" could be created in which the parallel postulate did not hold. (Gauss had also discovered but suppressed the existence of non-Euclidean geometries.)

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The Dark Middle Age (400. - 1250.)

- The classic world exists about 800 years from 400 BC. up to 400 AD.)

- The Demolition of the Alexandrian Library (Hypatia - the last librarian of the Alexandrian Library) 400 AD, is taken as the beginning of a dark Middle Ages dominated by Religion and Religious Mysticism.

- In the "dark" Middle Ages it is only enough to believe "After Jesus has no curiosity, there is no research after the Gospel. Believe it and want nothing more". (Tertulian, in the 3rd century)
Linear Perspective - Absolute and Flat Euclidean Space
How to think spatially?

Greeks and Romans developed the skill to show 3d in 2d, the skill of perspective was lost in the Middle Ages, but the Renaissance re-discovered it.
Giotto di Bondone, 1306. - hint of perspective
Nichoile d'Oresme, around 1360 introduces a new tool, graph, (x and y axis, horizontal and vertical), to show scientific results.

Graphic view today is an inescapable tool in science providing visualisation of data, abstract data are visualised.

Vertical and horizontal axes also use painters to organise space on canvas, indispensable painting techniques.

1435 Leon Batista Alberti publishes the book "Della pittura" in which he elaborates the drawing technique of the perspective.
Perspective & light & shade (Chiaroscuro, sfumato, ...)

Various painting techniques using light and shade to paint the time of the day or 3D perspective ... it is known where is the light source, where is shadow ... Leonardo: sfumato

Piero della Francesca, Nativity (c. 1470) - 124.5 x 123 cm, National Gallery, London
Caravaggio, The Calling of Saint Matthew
Renaissance - reason and logic

Leonardo da Vinci
1452 - 1519

Michelangelo
1475 - 1564

Raphael
1452 - 1519

Donatello
1452 - 1519

Nikola Kopernik
1473-1543

Galileo Galilei
1564 - 1642

Isac Newton
1643 - 1727

Rudjer Boskovic
1711 - 1787
Huma being is the hero, self-confident and enthusiastic: the main player!

Who will be the hero of the coming tomorrow?

a binary guy ?!
Newton’s prevailing concept of absolute space and time

Newton: “Absolute space, in its own nature, without reference to anything external remains always similar and unmovable.”

Nothing in space and time affects space or time; space and time are absolutely untouchable…

The space and time is the still whether one put into it a pea or some huge mass like a black hole...

The space and time are unaffected, completely detached from everything that is in the space and time.

Nothing influences the flow of time.

This is the predominant understanding of space and time until the beginning of the 20th century…
The first photography (writing with light)

1826 - The First Photograph, Joseph Nicéphore Niépce.

1872 photos confirmed:
The horse in the gallop has all four legs are in the air

Eadweard Muybridge

Paul Delaroche (1797-1856):
"From today painting is dead"
1824 K. F. Gauss, proposes a new non-euclidean geometry (never published ...)

1840 Nikolai I. Lobachevski, publishes a new geometry that does not apply to Euclid's fifth postulate. He is accused of sacrilege?!

In the non-Euclidian geometry the sum of angles in the triangle it is not 180° !!! ???

1854 Georg Riemann, a new non-euclidian science of space, the space is curved, the shortest distance between the two points is not the direction but the arch, there are no parallel lines ...

In Euclid's space, objects retain their shape and size.

In Riemann's space, the shape and size of an object depends on where the object is placed in space because the space is curved ... 😊
Different geometries of space

Positive Curvature  Negative Curvature  Flat Curvature
Modern Physics & Modern Art - questioning the common sense

Eduard Manet (1863.): The Luncheon on the Grass (Le déjeuner sur l'herbe)

"From now on I will be of our own time and work with what I see"

Model of atom (1911.)

No logical consistency
Space time paradigms

Paradigms up to 20 centuries on space and time:
- Euclid's space - a flat unbroken space is in the foundations of the objective world
- Time flows steadily and evenly everywhere and is always ticking at the same pace
- Time and space are absolute and nothing affects them
- There is always a clear causal relationship between events
- The 20th century - the new paradigm by Albert Einstein in his theory of relativities (1905 - special, 1915 - general)
- 1900 -1930 Quantum Mechanics
- Artists in the West discovered new ways of observing the world that is similar to the experience of space and space-time of primitive (illiterate) societies!
- The genuine artist always listen and resonates with the spirit of time, interrogates and interprets it in a holistic way.
- Johannes Kepler: "More clearly are seen by the eyes of the mind"
- Picasso: "I paint things as I think of them, not as I see them"
Space and time in a special theory of relativity

Einstein special theory of relativity:
For the light of all time is now all the space is here!
1907 Pablo Picasso visited an exhibition of African ceremonial masks - he is so shaken that he is literally shaking as if he has a fever.

He rushes to the studio, rejects Euclid geometry and Cubism occurs:

1907 creates "Les Demoiselles d'Avignon"

Chaotic (non-euclidean) conception of space

Umberto Boccioni 1911 (define the zeitgeist" of 20. century): "We are primitives of an unknown culture"
Portrait of Marie-Thérèse Walter (Pablo Picasso, 1937)
Several perspectives in the same painting
To make *3 Standard Stoppages*, Marcel Duchamp dropped three one-meter-long threads from the height of one meter onto three canvas strips. The threads were then adhered to the canvases, preserving the random curves they had assumed upon landing. Cut along the profiles of each fallen thread, the canvases served as templates for three draftsman’s straightedges—wood tools that retain the length of the meter but paradoxically “standardise” the accidental curve.

It is illusory is to talk about etalon of 1m, after Einstein's special theory of relativity.
Marcel Duchamp:
Nude Descending a Staircase, No. 2 (1912). Oil on canvas. 57 7/8" x 35 1/8". Philadelphia Museum of Art.

Duchamp: “An expression of time and space through the abstract presentation of motion”

Nude is observed in past present and future.

Did Marcel Duchamp knew Einstein ideas about space time?

Marcel Duchamp: “Art should not nourish the eye but the mind”
Marcel Duchamp

Revolving Glass (1923)  The Large Glass (The Bride Stripped Bare By Her Bachelors)

Attempt to visualise 4d space and object changing in space through time.

Educate himself in 4d space and perspective.
Vincent van Gogh: ”Really, we could speak only through our paintings.”

The thought embodied in colour.

The painting is made of a colour that is pure energy.
Paul Cozen (Apple and Biscuits, 1882.) & Gravity

The table is inclined, apples should fall down!
Cezanne questions the relationship between mass and space?
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Gravity - space-time geometry

Salvador Dali: Agnostic Symbol (1932.)

Physics textbook!
J. Wheeler: Matter tells spacetime how to curve and spacetime tells matter how to move.

Henry Moore: Internal and External Forms (1953)
Abstract painting & Black Hole

Ad Reinhardt / Black Paintings, 1963 MoMA
Brutal negation of any image

Create painting devoid of image, colour and light
Ad Reinhardt:
looking for image: ”breathless, timeless, styleless,, lifeless, deathless, endless “
”Looking is not so simple as it looks”

Event Horizon Telescope: Black Hole Painting

All is contained in Black (Hole) :)

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Abstract Art

&

Elementary Particle Physics/Quantum Filed Theory
Elementary particle physics is based on quantum field theory - mental abstraction.

Quantum field is the most abstract concept invented by humankind.

It is the underlying entity of what the universe is made off.

Physical reality are those things whose mass, charge and spin could be measured and we call it elementary particles.

Presence of an elementary particle at certain position in space and certain moment in time in fact is the disturbance/excitation of the quantum filed.

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What is more fundamental, what is the substance? Particle or QF?

J. Schwinger (S2001)
...these two distinct classical concepts [particles and fields] are merged and become transcended in something that has no classical counterpart – the quantised field that is a new conception of its own, a unity that replaces the classical duality.
https://www.quantum-field-theory.net/look-inside/

Universe is made of Quantum Fields
The universe is in fact made of quantum fields, the quantum field is more important than the particle, the process precedes the particle. Universe exist because the QF interact ...

- The field can not be captured and put under a microscope for research, and it only shows its existence through the influence of particles behaviour ("res")
- The word reality comes from the Latin word "res" meaning the thing and the reality is made of things.
- 2500 year-old Western thinkers learn that the universe is built of "particles" that exist in space and time.
- The QF is indestructible, exist also in void, and the processes that take place in the "emptiness" form our universe ...

Painters too, Kandinsky begin to explore the idea of art without image .... starting in 1910 by Kandinsky, looking for the fundamental substance of painting ...

- Abstract painting like does not images "res", but visualisation of the interaction between "res".
- Malevich: "Art does not need us, and it never needed us, ever since the stars were shining for the first time in the sky."
Abstract painting - elementary painting

Kazimir Malevich: Black Square 1913
© State Tretyakov Gallery, Moscow
Jackson Pollock (Jack the Dripper) is considered the most revolutionary abstract painter.

Pollock painting does not show “thing” in the context of the homogenous and linear space and time, trying to seize “now”

Pollock shows the moment of the creative “process” - process is the subject matter of art ... showing what he did and not what he has seen

People are confused with Pollock’s paintings, as well as with modern physics 🤔
Cloud chamber
Barnett Newman. “Central issue of painting is the subject of matter - what to paint”

Barnett Newman, *Vir Heroicus Sublimes* (1950-1951), The Museum of Modern Art, New York. A woman standing there [looking at it]...was covered with red," he recalled. "I realised it was the light shining on the painting reflecting back, filling the space between the viewer and the artwork that created the space, the place. And that reflection of the self of the painting, the painting as the subject reflected on the viewer, was a wholly new category of experience.” (2.5 x 5.5 m)
Line spectrum (colour) - atom fingerprint
Barnett Newman, 1942., The Death of Euclid (painting is the space itself)
CMS is artwork - efficiency encoded in its beauty
CMS is art tool - visualise the underlying structure of the universe

More clearly is seen by the eye of the mind
Quantum field precedes elementary particle
Where Do We Come From? What Are We? Where Are We Going

Paul Gauguin, *Where do we come from? What are we? Where are we going?,* 1897-98, oil on canvas, 139.1 x 374.6 cm
(Museum of Fine Arts, Boston) P. P. Gauguin, 1897
Public lecture to the high school students of fine art

Explain the basic physical concept and try to teach them how to think and make conclusion based on them

Discussion with students aiming to inspire scientific thoughts which shall be painted on the wall

Competitive process of selection
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Few thoughts about outreach

Outreach is necessity since many science skeptics have the power to shape important policy decisions regarding the future of research.

Success of outreach activity is not just a number “likes” collected by some outreach activity

Purpose of the outreach is the public education and particularly to elucidate the scientific method showing the ... how to think step by step to come to the complex thought and please show at least one equation (equation is the crown of the human creativity)

Sometimes art is prone to shrink/(disgust) of the science like that science is going to spoil the spirit of art and dirty the artwork

Synergy between art & science should have far more reacher outreach even to the public which is not science fun ...
Finally my artwork
Thank you!